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मानक

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Mazdoor Kisan Shakti Sangathan

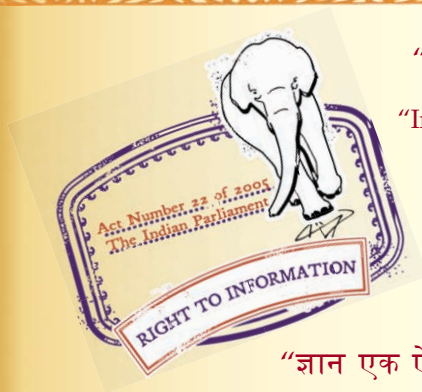
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“Step Out From the Old to the New”

IS 1248-2 (2003): Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories, Part 2: Ammeters and Voltmeters [ETD 12: Measuring Equipment for Basic Electrical Quantities]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

प्रत्यक्ष क्रियाशील सूचक अनुरूप वैद्युत मापन
उपकरण तथा उनके सहायक उपकरण
भाग 2 एममीटरों तथा वोल्टमीटरों की विशेष अपेक्षाएँ
(तीसरा पुनरीक्षण)

Indian Standard

DIRECT ACTING INDICATING ANALOGUE
ELECTRICAL MEASURING INSTRUMENTS
AND THEIR ACCESSORIES

PART 2 SPECIAL REQUIREMENTS FOR AMMETERS AND VOLTMETERS

(Third Revision)

ICS 17.220.20

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

**AMENDMENT NO. 1 AUGUST 2007
TO
IS 1248 (PART 2) : 2003 DIRECT ACTING
INDICATING ANALOGUE ELECTRICAL
MEASURING INSTRUMENTS AND
THEIR ACCESSORIES**

**PART 2 SPECIAL REQUIREMENTS FOR
AMMETERS AND VOLTMETERS**

(Third Revision)

(Page 3, Table 1, col 4) — Substitute '5.6', '5.7.1', '5.8.1', and '5.5' for '3.6', '3.7.1', '3.8.1' and '3.5' respectively.

(Page 4, clause 7.4.2, first para) — Substitute '6.4' for '4.4'.

(Page 5, clause 7.6, first para) — Substitute '6.9' for '4.9'.

Indian Standard

**DIRECT ACTING INDICATING ANALOGUE
ELECTRICAL MEASURING INSTRUMENTS
AND THEIR ACCESSORIES**

PART 2 SPECIAL REQUIREMENTS FOR AMMETERS AND VOLTMETERS

(Third Revision)

1 SCOPE

1.1 This standard (Part 2) covers the requirements of direct acting indicating ammeters and voltmeters having an analogue display

NOTE For multi-function instruments, see IS 1248 (Part 7)

1.2 This part also applies to non-interchangeable accessories as defined in 2.1.1 and 5.3 of IS 1248 (Part 1)

2 REFERENCES

The following standards are necessary adjuncts to this standard

<i>IS No</i>	<i>Title</i>
1248	Direct acting indicating analogue electrical measuring instruments and their accessories
(Part 1) 2003	Definitions and general requirements (<i>fourth revision</i>)
(Part 7) 2003	Multi-function instrument (<i>third revision</i>)
(Part 9) 2003	Test methods (<i>third revision</i>)

3 DEFINITIONS

Definitions given in IS 1248 (Part 1) shall be applicable

4 DESCRIPTION, CLASSIFICATION AND COMPLIANCE

4.1 Description

Ammeters and voltmeters shall be described according to their method of operation as given in 2.2 of IS 1248 (Part 1)

4.2 Classification

Ammeters and voltmeters shall be classified in one of the accuracy classes denoted by the following class indices

0.05, 0.1, 0.2, 0.3, 0.5, 1, 1.5, 2, 2.5, 3, and 5

Separate accuracy class to be stated on the dial if the same instrument is to be used for the measurement of a.c. and d.c.

4.3 For compliance with the requirements of this standard, see IS 1248 (Part 1)

5 REFERENCE CONDITIONS AND INTRINSIC ERRORS

5.1 Reference Conditions

The provisions of 5.1 of IS 1248 (Part 1) shall be applicable

5.2 Limits of Intrinsic Error, Fiducial Value

The provisions of 5.2 of IS 1248 (Part 1) shall be applicable

5.2.1 Correspondence between intrinsic error and accuracy class

The provisions of 5.2.1 of IS 1248 (Part 1) shall apply

5.2.2 Fiducial Value

The fiducial value for an ammeter or a voltmeter corresponds to 5.2.2.1 to 5.2.2.4

5.2.2.1 The upper limit of the measuring range for the following:

- a) Instruments with the mechanical and/or electrical zero at one end of the scale,
- b) Instruments with the mechanical zero outside the scale irrespective of the position of the electrical zero, and
- c) Instruments with the electrical zero outside the scale irrespective of the position of the mechanical zero

The class index is marked using Symbol E-1 given in 9 and Table 3 of IS 1248 (Part 1)

5.2.2.2 The sum of the electrical values, irrespective of sign, corresponding to the two limits of the

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measuring range when both the mechanical and the electrical zeros are displaced within the scale.

The class index is marked using Symbol E-1 given in 9 and Table 3 of IS 1248 (Part 1).

5.2.2.3 The span for an instrument whose scale marks do not correspond directly to its electrical input quantity.

The class index is marked using Symbol E-10 given in 9 and Table 3 of IS 1248 (Part 1).

The sub-clause does not apply to a voltmeter or ammeter designed to be used in conjunction with a shunt, a series resistor (impedance) or an instrument transformer. These instruments are to be treated in accordance with 5.2.2.1 or 5.2.2.2 as appropriate.

5.2.2.4 For an instrument whose scale has been arranged to produce a special arrangement of scale marks, the fiducial value (and therefore the permissible error) shall be as agreed to between the manufacturer and the user. The fiducial value does not have to be the same at all points on the scale.

6 NOMINAL RANGE OF USE AND VARIATIONS

6.1 Nominal Range of Use

The provisions of 6.1 of IS 1248 (Part 1) and Table 1 shall apply.

6.2 Limits of Variations

The provisions of 6.2 of IS 1248 (Part 1) and Table 1 shall be applicable.

6.3 Conditions for the Determination of Variations

The provisions of 6.3 of IS 1248 (Part 1) shall be applicable.

7 FURTHER ELECTRIC AND MECHANICAL REQUIREMENTS

7.1 Voltage Tests, Insulation Tests and Other Safety Requirements

For a fixed ammeter having the upper limit of its measuring range of 1A to 10A and intended for use with a current transformer having a high over-current capability, the measuring circuit shall not open when the ammeter is subjected to 30 times the nominal secondary current of the associated current transformer for a period of 2 s.

A portable ammeter intended for similar use shall withstand 15 times the upper limit of its measuring range for a period of 2 s.

These ammeters need not be functional after application of this overload but shall not then be open-circuit.

For the recommended tests, *see* 4.8 of IS 1248 (Part 9).

7.2 Damping

The provisions of 7.2 of IS 1248 (Part 1) shall be applicable.

7.2.1 Overshoot

The provisions of 7.2.1 of IS 1248 (Part 1) shall be applicable.

7.2.2 Response Time

The provisions of 7.2.2 of IS 1248 (Part 1) shall be applicable.

However, the requirements of 7.2.1 and 7.2.2 of IS 1248 (Part 1) do not apply to the following types of ammeters and voltmeters:

- a) Thermal instruments;
- b) Electrostatic instruments;
- c) Instruments having a freely suspended moving element;
- d) Instruments having a material pointer longer than 150 mm;
- e) Instruments in which the current or voltage corresponding to the upper limit of the measuring range is less than 200 μ A or 20 mV; and
- f) Special-purpose instruments where other response times may be required. Such instruments will be the subject of agreement between the manufacturer and the user.

7.2.3 Impedance of the External Measuring Circuit

The provisions of 7.2.3 of IS 1248 (Part 1) shall be applicable.

However, if the impedance of the external measuring circuit is not stated, it shall be assumed to be, at the reference frequency:

- a) More than 50 times the impedance of the instrument for ammeters, milliammeters and microammeters; and
- b) Less than 1/50 of the impedance of the instrument for voltmeters and millivoltmeters.

7.3 Self-Heating

The provisions of 7.3 of IS 1248 (Part 1) shall apply.

7.4 Permissible Overloads

7.4.1 Continuous Overload

For the test method, *see* 4.6 of IS 1248 (Part 9).

Ammeters and voltmeters, together with their non-interchangeable accessory(ies), if any, except for

**Table 1 Limits of the Nominal Range of Use and Permissible Variations
Additional to Those Given in Table 2 of IS 1248 (Part 1)
(Clauses 6.1 and 6.2)**

Influence Quantity		Limits of the Nominal Range of Use Unless Otherwise Marked	Permissible Variation Expressed as a Percentage of the Class Index		For the Recommended Tests, Ref to Cl of IS 1248 (Part 9)
(1)		(2)	(3)		(4)
Ripple (45 Hz to 65 Hz and 90 Hz to 130 Hz) on d.c. measured quantity for other than r.m.s. responding instruments (see Note 1)		20 percent	50 percent		3.6
Distortion of a.c. measured quantity for other than rectifier instruments (see Note 2)	Distortion factor	Instruments without electronic devices in their measuring circuits; 20 percent	100 percent		3.7.1
	Peak factor	Instruments having electronic devices in their measuring circuits; 1 to 3 (see Note 3)	100 percent		Under consideration
Frequency of ac measured quantity		Reference frequency ± 10 percent or lower limit of reference range for frequency -10 percent and upper limit of reference range for frequency $+10$ percent	100 percent		3.8.1
Magnetic field of external origin	0.4 kA/m	Moving magnet, moving iron and electrodynamic instruments if not astatic and/or not having a magnetic screen	Class indices 0.3 and smaller	Class indices 0.5 and greater	3.5
			3 percent of the fiducial value (see Note 4)	6 percent of the fiducial value (see Note 4)	
			Ferrodynamic instruments if not astatic and/or not having a magnetic screen	1.5 percent of the fiducial value (see Note 4)	
			All other instruments	0.75 percent of the fiducial value (see Note 4)	

NOTES

1 For an r.m.s. responding instrument which also responds to d.c., no permissible variation can be stated because the ripple is then part of the measured quantity.

2 For a.c. quantities, the requirements for instruments relate to r.m.s. values irrespective of the principle of operation of the instrument. However, instruments incorporating rectifier(s) (except r.m.s. responding instruments) usually respond to the rectified (mean) value of the waveform but are scaled to indicate the r.m.s. value of a sinusoidal waveform. If the waveform is not sinusoidal, the indicated value may be seriously in error. However, if the waveform can be adequately characterized, this error is calculable.

Requirements for the influence of a distorted waveform on rectified (mean) and peak-sensing instruments are therefore not specified.

3 The permissible variation due to a peak factor of other than $\sqrt{2}$ (corresponding to a sine wave) is included in the permissible variation due to distortion of the measured quantity.

For instruments having a peak factor capability greater than 3, the manufacturer shall state:

- Instrument peak factor capability producing a variation of 100 percent of the class index;
- Upper and lower limits of the frequency response (bandwidth) to 0.707 times the indication at the reference frequency;
- Effective maximum rate of change of internal instrument a.c. amplifier response (slew rate), expressed in volts per second using appropriate S.I. prefixes.

Peak factor relates to the total peak factor capability of the instrument and includes both the peak factor due to a distorted waveform and the peak factor due to spurious impulses (which may be random or harmonically related to the fundamental frequency) containing negligible average power.

4 Not as a percentage of the class index.

instruments fitted with a non-locking switch, shall be subject to a continuous overload of 120 percent of the upper limit of the electrical input quantity for a period of 2 h.

After removal of the excitation, the sum of the temporary and any permanent residual deflections shall not exceed 1 percent of the scale length.

After having cooled to the reference temperature, the instrument together with its non-interchangeable accessory(ies), if any, shall comply with its accuracy requirements; however, the overload shall not be repeated.

The continuous overload test shall be carried out under reference conditions.

7.4.2 Overloads of Short Duration

For the test method, see 4.4 of IS 1248 (Part 9).

Ammeters and voltmeters, together with the non-interchangeable accessory(ies), if any, shall be subjected to overloads of short duration.

However, these requirements do not apply to:

- a) Thermocouple instruments;
- b) Electrostatic instruments; and
- c) Instruments having a freely suspended moving element; unless these instruments are internally protected against overloads of short duration.

7.4.2.1 The values of current and voltage for the overloads of short duration shall be the product of the relevant factor given in Table 2 and the value of the upper limit of the electrical input quantity unless other values are stated by the manufacturer. External shunt operated millivoltmeters should be treated as voltmeters only.

7.4.2.2 The full duration of each overload shall be applied except when an automatic cut-out (fuse) fitted to the instrument has interrupted the circuit in less than the time specified in Table 2.

The automatic cut-out shall be reset (or the fuse replaced) before the application of the next overload.

7.4.2.3 After having been subjected to the overloads of short duration and after having cooled to the reference temperature, ammeters and voltmeters whose mechanical zero is within the scale, together with their non-interchangeable accessory(ies), if any, shall comply with both of the following requirements:

- a) Deviation of the index from the zero scale mark, expressed as a percentage of the scale length, shall not exceed the following value:
 - 1) 0.5 for instruments of class indices 0.3 and smaller, and
 - 2) Class index for instruments of class indices 0.5 and greater.
- b) Ammeter or voltmeter together with its non-interchangeable accessory(ies), if any, after adjustment of the zero (if necessary) shall comply with the accuracy requirements; however, the overloads shall not be repeated.

An ammeter or voltmeter whose mechanical zero is outside the scale is considered to have complied with this requirement, if, after having cooled to the reference temperature, it has errors not exceeding those relating to its class index; however, the overloads shall not be repeated.

7.5 Limiting Values of Temperature

The provisions of 7.5 of IS 1248 (Part 1) shall be applicable.

Table 2 Overloads of Short Duration
(Clauses 7.4.2.1 and 7.4.2.2)

Instrument	Current Factor	Voltage Factor	Number of Overloads	Duration of Each Overload in seconds	Interval Between Successive Overloads in seconds
(1)	(2)	(3)	(4)	(5)	(6)
<i>Instruments of class indices 0.5 and smaller and rectifier instruments of all class indices</i>					
Ammeters	2		5	0.5	15
Voltmeters		2	5	0.5	15
<i>Instruments of class indices 1 and greater</i>					
Ammeters	10	—	9	0.5	60
	10	—	1	5	
Voltmeters	—	2	9	0.5	60
		2	1	5	

NOTE - Where two series of tests are specified, they should both be carried out, in the order given.

7.6 Deviation from Zero

For the test method, see 4.9 IS 1248 (Part 9)

7.6.1 If an ammeter or a voltmeter has a zero position marked on the scale, it shall be tested for return to zero when de-energized. The test shall be carried out under reference conditions.

7.6.2 After a period of energization of 30s at the upper limit of the measuring range, the deviation of the index from the zero scale mark, expressed as a percentage of the scale length, shall not exceed a value corresponding to 50 percent of the class index.

8 CONSTRUCTIONAL REQUIREMENTS

8.1 The provisions of 8.1 of IS 1248 (Part 1) shall be applicable.

8.2 The provisions of 8.2 of IS 1248 (Part 1) shall be applicable.

8.3 The provisions of 8.3 of IS 1248 (Part 1) shall be applicable.

8.4 Preferred Values

8.4.1 The upper limit of the measuring range for ammeters and voltmeters shall preferably be one of the following values:

1, 1.2, 1.5, 2, 2.5, 3, 4, 5, 6, 7.5, 8 or their decimal multiples and sub-multiples.

For multi-range instruments, at least one of the ranges shall preferably comply with this requirement.

8.4.2 The voltage drop at the upper limit of the measuring range for an ammeter intended for use with an external shunt shall preferably be one of the following values:

50mV, 60mV, 75mV, 100mV, 300mV

8.4.3 If, to achieve the correct performance of an instrument, it is necessary to use calibrated instrument leads (that is leads having a specified value of resistance) to connect it to a shunt, the manufacturer shall state the value of the lead resistance.

Unless otherwise stated by the manufacturer, the value of the total resistance of the calibrated instrument leads shall not exceed 70 mΩ at the reference temperature.

The value of the lead resistance shall not differ from the stated value by more than 10 percent at the reference temperature.

8.5 Adjuster(s), Mechanical and/or Electrical

The provisions of 8.4 of IS 1248 (Part 1) shall be applicable.

8.6 Effects of Vibration and Shock

The provisions of 8.5 of IS 1248 (Part 1) shall be applicable.

9 INFORMATION, GENERAL MARKINGS AND SYMBOLS

The provisions of 9 of IS 1248 (Part 1) shall be applicable.

10 MARKINGS AND SYMBOLS FOR TERMINALS

The provisions of 10.1 to 10.3 of IS 1248 (Part 1) shall apply.

10.1 Special Markings for Terminals

All terminals shall be marked so that they can be uniquely identified.

10.1.1 Single Range d.c. Ammeters and Voltmeters

The positive terminal shall be marked using Symbol F-46 (+) given in Table 3 of IS 1248 (Part 1).

10.1.2 Multi-Range d.c. Ammeters and Voltmeters

The range-selecting terminals shall be marked with the value corresponding to the upper limit of the relevant measuring range. If those terminals are positive terminals, they shall also be marked using Symbol F-46 (+) given in Table 3 of IS 1248 (Part 1). This marking shall follow the marking for the value of the range. If the common terminal is the positive terminal, it shall be marked using Symbol F-46 (+) given in Table 3 of IS 1248 (Part 1).

10.1.3 Single Range a.c. Ammeters and Voltmeters

In the absence of special requirements, no markings are needed.

10.1.4 Multi-Range a.c. Ammeters and Voltmeters

The range-selecting terminals shall be marked with the value corresponding to the upper limit of the measuring ranges.

11 TESTS TO PROVE COMPLIANCE WITH THIS STANDARD

The provisions of 11 of IS 1248 (Part 1) shall be applicable.

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Amendments Issued Since Publication

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BUREAU OF INDIAN STANDARDS

Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002
Telephones : 2323 0131, 2323 33 75, 2323 9402

Telegrams : Manaksanstha
(Common to all offices)

Regional Offices :

	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110 002	{ 2323 7617 2323 3841
Eastern : 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700 054	{ 2337 8499, 2337 8561 2337 8626, 2337 9120
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160 022	{ 60 3843 60 9285
Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600 113	{ 2254 1216, 2254 1442 2254 2519, 2254 2315
Western : Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400 093	{ 2832 9295, 2832 7858 2832 7891, 2832 7892
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